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# Effect of Molybdenum and Sulphur on Growth and Yield of Summer Black Gram (*Vigna mungo* L.)

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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***Original Research Article***

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## ABSTRACT

A field experiment was conducted during *Zaid* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) to study treatments consisting of three levels of Molybdenum *viz.* Mo 1 kg, 1.5 kg and 2 kg/ha and three levels of Sulphur *viz*. 10, 20 and 30 kg/ha. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28 %), available N (225 kg/ha), available P (19.50 kg/ha) and available K (92 kg/ha). Ten treatments were replicated thrice and laid out in Randomized Block Design. The results revealed that treatment nine (Molybdenum2kg/ha+ Sulphur 30kg/ha) recorded significantly higher plant height (42.54 cm), number of branches/plants (6.93), number of leaves/plants (15.00), plant dry weight (5.27 g), number of nodules/plants (20.60), number of pods/plant (27.6), number of seeds/pod (9.53), seed yield (1.25 t/ha), stover yield (2.87), harvest index (30.3%), gross returns (87500.00), net returns (47281.52)and B:C ratio (1.18) as compared to other treatments.

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## 1. INTRODUCTION

"Black gram *(Vigna mungo L.)* is one of the important pulse crops grown throughout India. Black gram productivity must be increased with proper fertilisation. It could meet its nitrogen requirements by symbiotic fixation of atmospheric nitrogen. It works well in many intensive crop rotations since it is a short-duration crop that can adapt to the off-season. It is eaten as "dal" (whole or split, husked and unhusked), or it can be parched. It is 'papad's' main ingredient [1-3]. It is used as nutritive fodder, especially for mulch cattle, and as a green manuring crop. It enriches the soil by 42kg N ha-1. It is a crop with a high protein content (26%) and makes up 10% of all the pulses produced in a nation" (Gowda et al., 2013). "The most promising feature of pulses is their ability to fix atmospheric nitrogen. It has been reported that black gram produces 22.10kg N ha-1yr-1 which supplements fifty-nine thousand tons of urea annually" (Jat et al., 2017). A proportionate number of macro and micronutrients is essential for the necessary bacterial activity to accelerate nodulation and promote growth for improved black gram production [4-6]. Black gram contains about 24% protein, 60% carbohydrate,10.9% moisture, 1.4% fat,0.9% fibre,3.2% minerals and vitamin viz. calcium 154 mg, phosphorous 385 mg, iron 9.1 mg and a small amount of vitamin B complex. It contains 78%-80% nitrogen in the form of albumin and globulin. Black gram has been distributed mainly in tropical to subtropical countries. In India black gram is grown on a 39.43 lakh ha area with a total production of 20.5 lakh tones and productivity of 532 kg/ha (agricoop.nic.in). "Molybdenum is one of the most recognized nutrient elements considered essential for plant growth and planning an important role in the structural interring of cell walls and cell membranes and synthesis of protein as well as nitrogen fixation. Legume also contributes to the symbiotic fixation of nitrogen" [7-9]. "Nitrogenase, an enzyme that fixes nitrogen, is a molybdenum compound. This element is necessary for nitrogen fixing to take place. Low levels of molybdenum result in poor seed output in pulse crops, so it has become a crucial micronutrient. The enzymes nitrogenase and nitrate reductase have this structural component, which causes oxidation-reduction processes in plant cells" [10].

Sulphur is an important secondary essential plant nutrient. It is crucial for physiological activities like the synthesis of chlorophyll and sulphur-containing amino acids (cystine and methionine). Additionally, it produces coenzymes A, synthesises some vitamins (including biotin and thiamine), and regulates the metabolism of protein, fat, and carbs. In legumes, it also encourages nodulation. Sulphur can be quite beneficial in this regard for increasing the yield of pulses like black gram [11-13]. "Restricted use of Sulphur is recognized as the fourth major plant nutrient after Nitrogen, phosphorous and potassium. It plays an important role in many plant processes like metabolism, which is dependent upon sulphur and its deficiency causes primary metabolic impairment. In plants, sulphur concentrations are found to be lower than nitrogen" (Saito K et al., 2004).

## 2. MATERIALS AND METHODS

The experiment was conducted during the *Zaid* season of 2022. The experiment was conducted in a Randomized Block Design consisting of 10 treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with a low level of organic carbon (0.28%), available N (225 Kg/ha), P (19.50 kg/ha) and a higher level of K (92.00 kg/ha). The treatment combinations are $T_1$ – Molybdenum 1kg/ha + Sulphur 10kg/ha, $T_2$ – Molybdenum 1 kg/ha + Sulphur 20 kg/ha $T_3$- Molybdenum 1 kg/ha + Sulphur 30 kg/ha, $T_4$ – Molybdenum 1.5 kg/ha + Sulphur 10 kg/ha, $T_5$ – Molybdenum 1.5 kg/ha + Sulphur 20 kg/ha, $T_6$ – Molybdenum 1.5 kg/ha + Sulphur 30k g/ha, $T_7$ – Molybdenum 2 kg/ha + Sulphur 10 kg/ha, $T_8$- Molybdenum 2 kg/ha + Sulphur 20 kg/ha, $T_9$ – Molybdenum 2 kg/ha+ Sulphur 30 kg/ha, $T_{10}$- Control 25:50:25(NPK kg/ha). The observations were recorded on different growth parameters at harvest *viz.* plant height(cm), number of branches/plants, number of leaves/plant, plant dry weight, number of nodules/plant, number of pods/ plant, number of seeds/ pod, seed yield, stover yield.

## 3. RESULTS AND DISCUSSION

### A. Growth Attributes

At 45 DAS, treatment with Molybdenum 2 kg/ha+ Sulphur 30 kg/ha recorded significantly the

**Table 1. Effect of Molybdenum and Sulphur on growth attributes of Black gram**

| Treatment | Plant height (cm) AT 45 DAS | Number of branches/ plant AT 45 DAS | Number of leaves/plant AT 45 DAS | Plant dry weight (g/ plant) AT 45 DAS | Number of nodules/plant AT 45 DAS |
|---|---|---|---|---|---|
| Molybdenum 1kg/ha+ Sulphur 10kg/ha | 38.60 | 5.60 | 12.40 | 3.10 | 17.60 |
| Molybdenum 1kg/ha+ Sulphur 20kg/ha | 39.10 | 6.00 | 13.40 | 4.10 | 18.60 |
| Molybdenum 1kg/ha+ Sulphur 30kg/ha | 41.34 | 6.60 | 14.20 | 4.90 | 20.00 |
| Molybdenum 1.5kg/ha+ Sulphur 10kg/ha | 38.90 | 5.80 | 13.00 | 3.70 | 18.20 |
| Molybdenum 1.5kg/ha+ Sulphur 20kg/ha | 39.20 | 6.20 | 13.80 | 4.50 | 19.00 |
| Molybdenum 1.5kg/ha+ Sulphur 30kg/ha | 41.94 | 6.87 | 14.80 | 5.19 | 20.40 |
| Molybdenum 2kg/ha+ Sulphur 10kg/ha | 39.00 | 5.80 | 13.20 | 3.90 | 18.40 |
| Molybdenum 2kg/ha+ Sulphur 10kg/ha | 39.80 | 6.40 | 14.00 | 4.70 | 19.20 |
| Molybdenum 2kg/ha+ Sulphur 30kg/ha | 42.54 | 6.93 | 15.00 | 5.27 | 20.60 |
| Control 25:50:25 (NPK kg/ha) | 37.76 | 5.40 | 11.93 | 2.70 | 17.27 |
| SEm(±) | 0.57 | 0.16 | 0.15 | 0.04 | 0.15 |
| CD at 5% | 1.68 | 0.47 | 0.45 | 0.11 | 0.43 |

**Table 2. Effect of molybdenum and Sulphur on yield attributes of Black gram**

| Treatments | No. of pods/ Plant | No. of Seeds/ Pod | Test Weight (g) | Seed yield (t/ha) | Stover Yield (t/ha) | Harvest index (%) |
|---|---|---|---|---|---|---|
| Molybdenum 1kg/ha+ Sulphur 10kg/ha | 20.40 | 7.20 | 28.00 | 0.83 | 2.40 | 25.50 |
| Molybdenum 1kg/ha+ Sulphur 20kg/ha | 21.40 | 8.00 | 27.40 | 0.99 | 2.56 | 27.83 |
| Molybdenum 1kg/ha+ Sulphur 30kg/ha | 25.60 | 9.00 | 26.60 | 1.12 | 2.69 | 28.49 |
| Molybdenum 1.5kg/ha+ Sulphur 10kg/ha | 21.00 | 7.40 | 29.80 | 0.87 | 2.44 | 26.24 |
| Molybdenum 1.5kg/ha+ Sulphur 20kg/ha | 22.20 | 8.20 | 29.20 | 1.03 | 2.60 | 28.19 |
| Molybdenum 1.5kg/ha+ Sulphur 30kg/ha | 27.00 | 9.27 | 29.80 | 1.22 | 2.77 | 30.34 |
| Molybdenum 2kg/ha+ Sulphur 10kg/ha | 21.20 | 7.80 | 31.20 | 0.93 | 2.50 | 26.98 |
| Molybdenum 2kg/ha+ Sulphur 20kg/ha | 24.20 | 8.60 | 30.60 | 1.06 | 2.63 | 28.22 |
| Molybdenum 2kg/ha+ Sulphur 30kg/ha | 27.60 | 9.53 | 29.00 | 1.25 | 2.87 | 30.14 |
| Control 25:50:25(NPK kg/ha) | 20.00 | 7.00 | 28.87 | 0.79 | 2.36 | 24.57 |
| SEm (±) | 0.28 | 0.11 | 0.95 | 0.07 | 0.08 | 1.02 |
| CD at 5% | 0.84 | 0.33 | -- | 0.22 | 0.25 | 3.03 |

highest plant height (42.54 cm). However, treatments with Molybdenum 1 kg/ha+ Sulphur 30 kg/ha (41.34) and Molybdenum 1.5 kg/ha+ Sulphur 30 kg/ha (41.94) were statistically at par with the treatment Molybdenum 2 kg/ha+ Sulphur 30 kg/ha. At 45 DAS, treatment with Molybdenum 2 kg/ha+ Sulphur 30 kg/ha recorded the significantly highest number of branches per plant (6.93). However, treatments with Molybdenum 1 kg/ha+ Sulphur 30 kg/ha (6.60) and Molybdenum 1.5 kg/ha+ Sulphur 30 kg/ha (6.87) were statistically at par with the treatment Molybdenum 2 kg/ha+ Sulphur 30 kg/ha. At 45 DAS, treatment with Molybdenum 2 kg/ha+ Sulphur 30 kg/ha recorded the significantly highest number of leaves per plant (15.00). However, treatment with Molybdenum 1.5 kg/ha+ Sulphur 30 kg/ha (14.80) was statistically at par with the treatment Molybdenum 2 kg/ha+ Sulphur 30 kg/ha. AT 45 DAS treatment with Molybdenum 2 kg/ha+ Sulphur 30 kg/ha recorded significantly highest plant dry weight (5.27 g). However, treatment with Molybdenum 1.5 kg/ha+ Sulphur 30 kg/ha (5.19) was statistically at par with the treatment Molybdenum 2 kg/ha+ Sulphur 30 kg/ha. At 45 DAS, treatment with Molybdenum 2 kg/ha+ Sulphur 30 kg/ha recorded significantly the highest Number of nodules/plant (20.60). However, treatment Molybdenum 1.5 kg/ha+ Sulphur 30 kg/ha (20.40) was statistically at par with the treatment Molybdenum 2 kg/ha+ Sulphur 30 kg/ha.

## B. Yield Attributes

Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded significantly the highest Number of pods per plant (27.6). However, treatment Molybdenum 1.5kg/ha+ Sulphur 30kg/ha (27.00) was statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha. Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded significantly the highest Number of seeds per pod (9.53). However, treatment Molybdenum 1.5kg/ha+ Sulphur 30kg/ha (9.27) was statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha. The highest test weight (31.20) was recorded in Treatment 7 with an application of Molybdenum 2kg/ha+ Sulphur 10kg/ha, though there was no significant difference among the treatments. Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded the highest seed yield (1.25 t/ha). However, treatment with Molybdenum 1kg/ha+ Sulphur 30kg/ha (1.12), Molybdenum 1.5kg/ha+ Sulphur 30kg/ha (1.22) and Molybdenum 2kg/ha+ Sulphur 20kg/ha (1.06) were statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha. Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded the highest stover yield (2.87 t/ha). However, treatment with Molybdenum 1kg/ha+ Sulphur 30kg/ha (2.69), Molybdenum 1.5kg/ha+ Sulphur 30kg/ha (2.77) and Molybdenum 2kg/ha+ Sulphur 20kg/ha (2.63) were statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha. Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded the highest biological yield (4.12 t/ha). However, treatment with Molybdenum 1kg/ha+ Sulphur 30kg/ha (3.18), Molybdenum 1.5kg/ha+ Sulphur 30kg/ ha (3.99) and Molybdenum 2kg/ha+ Sulphur 20kg/ha (3.69) were statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha. Treatment with Molybdenum 2kg/ha+ Sulphur 30kg/ha recorded the highest harvest index (30.3%). However, treatment with Molybdenum 1kg/ha + Sulphur 20kg/ha (27.83%), Molybdenum 1kg/ha+ Sulphur 30kg/ha (28.49%), Molybdenum1.5kg/ha+ Sulphur 20kg/ha (28.19%), Molybdenum1.5kg/ha+ Sulphur 30kg/ha (30.34%) and Molybdenum 2kg/ha+ Sulphur 20kg/ha (28.22%) were statistically at par with the treatment Molybdenum 2kg/ha+ Sulphur 30kg/ha.

## 4. CONCLUSION

From the results, it can be concluded that black gram with the application of Molybdenum 2 kg/ha and Sulphur 30kg/ha (treatment 9) recorded the highest plant height, seed yield and Benefit-cost ratio.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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